<110> Miller, Brian S.
Shetty, Jayarama K.

<120> Modified Forms of Pullulanase

<130> GC396-2

<140> 09/262,126
<141> 1999-03-03

<160> 9

<170> FastSEQ for Windows Version 3.0

<210> 1
<211> 2794
<212> DNA
<213> B. deramificans

<400> 1

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gctgactctt ttggagctgt tgcaagtgct gatattccag gaaacccaag tcaggtagga     180
attatcgttc gcactcaaga ttggaccaaa gatgtgagcg ctgaccgcta catagattta     240
agcaaaggaa atgaggtgtg gcttgtagaa ggaaacagcc aaattttta taatgaaaaa     300
gatgctgagg atgcagctaa acccgctgta agcaacgctt atttagatgc ttcaaaccag     360
gtgctggtta aacttagcca gccgttaact cttggggaag gnnnaagcgg ctttacggtt     420
catgacgaca cagcaaataa ggatattcca gtgacatctg tgaaggatgc aagtcttggt     480
caagatgtaa ccgctgtttt ggcaggtacc ttccaacata tttttggagg ttccgattgg     540
gcacctgata atcacagtac tttattaaaa aaggtgacta acaatctcta tcaattctca     600
ggagatcttc ctgaaggaaa ctaccaatat aaagtggctt aaatgatag ctggaataat     660
ccgagttacc catctgacaa cattaattta acagtccctg ccggcggtgc acacgtcact     720
ttttcgtata ttccgtccac tcatgcagtc tatgacacaa ttaataatcc taatgcggat     780
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acacagaaag caacaacctt taaagtctgg gcaccaactt ctaccaagt aaatgttctt    1020
ctttatgaca gtgcaacggg ttctgtaaca aaaatcgtac ctatgacggc atcgggccat    1080
ggtgtgtggg aagcaacggt taatcaaaac cttgaaaatt ggtattacat gtatgaggta    1140
acaggccaag gctctacccg aacggctgtt gatccttatg caactgcgat tgcaccaaat    1200
ggaacgagag gcatgattgt ggacctggct aaaacagatc ctgctggctg gaacagtgat    1260
aaacatatta cgccaaagaa tatagaagat gaggtcatct atgaaatgga tgtccgtgac    1320
ttttccattg accctaattc gggtatgaaa aataaaggga agtatttggc tcttacagaa    1380
aaaggaacaa agggccctga caacgtaaag acggggatag attccttaaa acaacttggg    1440
attactcatg ttcagcttat gcctgttttc gcatctaaca gtgtcgatga aactgatcca    1500
acccaagata attggggtta tgaccctcgc aactatgatg ttcctgaagg gcagtatgct    1560
acaaatgcga atggtaatgc tcgtataaaa gagtttaagg aaatggttct ttcactccat    1620
cgtgaacaca ttggggttaa catggatgtt gtctataatc ataccctttgc cacgcaaatc    1680
tctgacttcg ataaaattgt accagaatat tattaccgta cgatgatcca ggtaattata    1740
ccaacggatc aggtactgga aatgaaattg cangcngaaa ggccaatggt tcaaaaattt    1800
attattgatt cccttaagta ttgggtcaat gagtatcata ttgacggctt ccgtttttgac    1860
ttaatggcgc tgcttggaaa agacacgat tccaaagctg cctcggagct tcatgctatt    1920
aatccaggaa ttgcacttta cggtgagcca tggacgggtg gaacctctgc actgccagat    1980
gatcagcttc tgacaaaagg agctcaaaaa ggcatgggag tagcggtgtt taatgacaat    2040
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1

```
ttacgaaacg cgttggacgg caatgtcttt gattcttccg ctcaaggttt tgcgacaggt      2100
gcaacaggct taactgatgc aattaagaat ggcgttgagg ggagtattaa tgactttacc      2160
tcttcaccag gtgagacaat taactatgtc acaagtcatg ataactacac ccttttgggac     2220
aaaatagccc taagcaatcc taatgattcc gaagcggatc ggattaaaat ggatgaactc      2280
gcacaagcag ttgttatgac ctcacaaggc gttccattca tgcaaggcgg ggaagaaatg      2340
cttcgtanaa aaggcggcaa cgacaatagt tataatgcag gcgatgcggt caatgagttt      2400
gattggagca ggaaagctca atatccagat gttttcaact attatagcgg ctaatccac       2460
cttcgtcttg atcacccagc cttccgcatg acgacagcta atgaaatcaa tagccacctc       2520
caattcctaa atagtccaga gaacacagtg gcctatgaat taactgatca tgttaataaa       2580
gacaaatggg gaaatatcat tgttgtttat aacccaaata aaactgtagc aaccatcaat       2640
ttgccgagcg ggaaatgggc aatcaatgct acgagcggta aggtaggaga atccaccctt       2700
ggtcaagcag agggaagtgt ccaagtacca ggtatatcta tgatgatcct tcatcaagag       2760
gtaagcccag accacggtaa aaagtaatag aaaa                                   2794
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<210> 2
<211> 958
<212> PRT
<213> B. deramificans

<220>
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<222> (1)...(956)
<223> Xaa = Any Amino Acid

<220>
<221> VARIANT
<222> (957)...(957)
<223> Xaa = gap of indeterminate length

<400> 2
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 1               5                   10                  15
Thr Trp Ala Phe Asn Val Lys Gly Gln Ser Ala His Ala Asp Gly Asn
                20                  25                  30
Thr Thr Thr Ile Ile Val His Tyr Phe Cys Pro Ala Gly Asp Tyr Gln
            35                  40                  45
Pro Trp Ser Leu Trp Met Trp Pro Lys Asp Gly Gly Gly Ala Glu Tyr
        50                  55                  60
Asp Phe Asn Gln Pro Ala Asp Ser Phe Gly Ala Val Ala Ser Ala Asp
65                  70                  75                  80
Ile Pro Gly Asn Pro Ser Gln Val Gly Ile Ile Val Arg Thr Gln Asp
                85                  90                  95
Trp Thr Lys Asp Val Ser Ala Asp Arg Tyr Ile Asp Leu Ser Lys Gly
            100                 105                 110
Asn Glu Val Trp Leu Val Glu Gly Asn Ser Gln Ile Phe Tyr Asn Glu
        115                 120                 125
Lys Asp Ala Glu Asp Ala Ala Lys Pro Ala Val Ser Asn Ala Tyr Leu
    130                 135                 140
Asp Ala Ser Asn Gln Val Leu Val Lys Leu Ser Gln Pro Leu Thr Leu
145                 150                 155                 160
Gly Glu Gly Xaa Ser Gly Phe Thr Val His Asp Asp Thr Ala Asn Lys
                165                 170                 175
Asp Ile Pro Val Thr Ser Val Lys Asp Ala Ser Leu Gly Gln Asp Val
            180                 185                 190
Thr Ala Val Leu Ala Gly Thr Phe Gln His Ile Phe Gly Gly Ser Asp
        195                 200                 205
Trp Ala Pro Asp Asn His Ser Thr Leu Leu Lys Lys Val Thr Asn Asn
```

```
            210                    215                    220
Leu Tyr Gln Phe Ser Gly Asp Leu Pro Glu Gly Asn Tyr Gln Tyr Lys
225                    230                    235                    240
Val Ala Leu Asn Asp Ser Trp Asn Asn Ser Tyr Pro Ser Asp Asn Ile
                245                    250                    255
Asn Leu Thr Val Pro Ala Gly Gly Ala His Val Thr Phe Ser Tyr Ile
                260                    265                    270
Pro Ser Thr His Ala Val Tyr Asp Thr Ile Asn Asn Pro Asn Ala Asp
                275                    280                    285
Leu Gln Val Glu Ser Gly Val Lys Thr Asp Leu Val Thr Val Thr Leu
                290                    295                    300
Gly Glu Asp Pro Asp Val Ser His Thr Leu Ser Ile Gln Thr Asp Gly
305                    310                    315                    320
Tyr Gln Ala Lys Gln Val Ile Pro Arg Asn Val Leu Asn Ser Ser Gln
                325                    330                    335
Tyr Tyr Tyr Ser Gly Asp Asp Leu Gly Asn Thr Tyr Thr Gln Lys Ala
                340                    345                    350
Thr Thr Phe Lys Val Trp Ala Pro Thr Ser Thr Gln Val Asn Val Leu
                355                    360                    365
Leu Tyr Asp Ser Ala Thr Gly Ser Val Thr Lys Ile Val Pro Met Thr
                370                    375                    380
Ala Ser Gly His Gly Val Trp Glu Ala Thr Val Asn Gln Asn Leu Glu
385                    390                    395                    400
Asn Trp Tyr Tyr Met Tyr Glu Val Thr Gly Gln Gly Ser Thr Arg Thr
                405                    410                    415
Ala Val Asp Pro Tyr Ala Thr Ala Ile Ala Pro Asn Gly Thr Arg Gly
                420                    425                    430
Met Ile Val Asp Leu Ala Lys Thr Asp Pro Ala Gly Trp Asn Ser Asp
                435                    440                    445
Lys His Ile Thr Pro Lys Asn Ile Glu Asp Glu Val Ile Tyr Glu Met
                450                    455                    460
Asp Val Arg Asp Phe Ser Ile Asp Pro Asn Ser Gly Met Lys Asn Lys
465                    470                    475                    480
Gly Lys Tyr Leu Ala Leu Thr Glu Lys Gly Thr Lys Gly Pro Asp Asn
                485                    490                    495
Val Lys Thr Gly Ile Asp Ser Leu Lys Gln Leu Gly Ile Thr His Val
                500                    505                    510
Gln Leu Met Pro Val Phe Ala Ser Asn Ser Val Asp Glu Thr Asp Pro
                515                    520                    525
Thr Gln Asp Asn Trp Gly Tyr Asp Pro Arg Asn Tyr Asp Val Pro Glu
                530                    535                    540
Gly Gln Tyr Ala Thr Asn Ala Asn Gly Asn Ala Arg Ile Lys Glu Phe
545                    550                    555                    560
Lys Glu Met Val Leu Ser Leu His Arg Glu His Ile Gly Val Asn Met
                565                    570                    575
Asp Val Val Tyr Asn His Thr Phe Ala Thr Gln Ile Ser Asp Phe Asp
                580                    585                    590
Lys Ile Val Pro Glu Tyr Tyr Tyr Arg Thr Met Ile Gln Val Ile Ile
                595                    600                    605
Pro Thr Asp Gln Val Leu Glu Met Lys Leu Xaa Ala Glu Arg Pro Met
                610                    615                    620
Val Gln Lys Phe Ile Ile Asp Ser Leu Lys Tyr Trp Val Asn Glu Tyr
625                    630                    635                    640
His Ile Asp Gly Phe Arg Phe Asp Leu Met Ala Leu Leu Gly Lys Asp
                645                    650                    655
Thr Met Ser Lys Ala Ala Ser Glu Leu His Ala Ile Asn Pro Gly Ile
                660                    665                    670
```

3

```
Ala Leu Tyr Gly Glu Pro Trp Thr Gly Gly Thr Ser Ala Leu Pro Asp
        675                 680             685
Asp Gln Leu Leu Thr Lys Gly Ala Gln Lys Gly Met Gly Val Ala Val
        690                 695             700
Phe Asn Asp Asn Leu Arg Asn Ala Leu Asp Gly Asn Val Phe Asp Ser
705                 710             715                 720
Ser Ala Gln Gly Phe Ala Thr Gly Ala Thr Gly Leu Thr Asp Ala Ile
            725             730                 735
Lys Asn Gly Val Glu Gly Ser Ile Asn Asp Phe Thr Ser Ser Pro Gly
            740             745             750
Glu Thr Ile Asn Tyr Val Thr Ser His Asp Asn Tyr Thr Leu Trp Asp
        755                 760             765
Lys Ile Ala Leu Ser Asn Pro Asn Asp Ser Glu Ala Asp Arg Ile Lys
        770             775             780
Met Asp Glu Leu Ala Gln Ala Val Val Met Thr Ser Gln Gly Val Pro
785             790             795                 800
Phe Met Gln Gly Gly Glu Glu Met Leu Arg Xaa Lys Gly Gly Asn Asp
            805             810             815
Asn Ser Tyr Asn Ala Gly Asp Ala Val Asn Glu Phe Asp Trp Ser Arg
        820             825             830
Lys Ala Gln Tyr Pro Asp Val Phe Asn Tyr Tyr Ser Gly Leu Ile His
        835             840             845
Leu Arg Leu Asp His Pro Ala Phe Arg Met Thr Thr Ala Asn Glu Ile
        850             855             860
Asn Ser His Leu Gln Phe Leu Asn Ser Pro Glu Asn Thr Val Ala Tyr
865             870             875                 880
Glu Leu Thr Asp His Val Asn Lys Asp Lys Trp Gly Asn Ile Ile Val
            885             890                 895
Val Tyr Asn Pro Asn Lys Thr Val Ala Thr Ile Asn Leu Pro Ser Gly
        900             905             910
Lys Trp Ala Ile Asn Ala Thr Ser Gly Lys Val Gly Glu Ser Thr Leu
        915             920             925
Gly Gln Ala Glu Gly Ser Val Gln Val Pro Gly Ile Ser Met Met Ile
        930             935             940
Leu His Gln Glu Val Ser Pro Asp His Gly Lys Lys Xaa Lys
945                 950             955
```

        <210> 3
        <211> 718
        <212> PRT
        <213> B. subtilis

        <400> 3
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Met Val Ser Ile Arg Arg Ser Phe Glu Ala Tyr Val Asp Asp Met Asn
1               5               10              15
Ile Ile Thr Val Leu Ile Pro Ala Glu Gln Lys Glu Ile Met Thr Pro
            20              25              30
Pro Phe Arg Leu Glu Thr Glu Ile Thr Asp Phe Pro Leu Ala Val Arg
        35              40              45
Glu Glu Tyr Ser Leu Glu Ala Lys Tyr Lys Tyr Val Cys Val Ser Asp
        50              55              60
His Pro Val Thr Phe Gly Lys Ile His Cys Val Arg Ala Ser Ser Gly
65              70              75              80
His Lys Thr Asp Leu Gln Ile Gly Ala Val Ile Arg Thr Ala Ala Phe
            85              90              95
Asp Asp Glu Phe Tyr Tyr Asp Gly Glu Leu Gly Ala Val Tyr Thr Ala
        100             105             110
```

4

```
Asp His Thr Val Phe Lys Val Trp Ala Pro Ala Ala Thr Ser Ala Ala
        115                 120             125
Val Lys Leu Ser His Pro Asn Lys Ser Gly Arg Thr Phe Gln Met Thr
        130             135             140
Arg Leu Glu Lys Gly Val Tyr Ala Val Thr Val Thr Gly Asp Leu His
145             150                 155                 160
Gly Tyr Glu Tyr Leu Phe Cys Ile Cys Asn Asn Ser Glu Trp Met Glu
                165             170                 175
Thr Val Asp Gln Tyr Ala Lys Ala Val Thr Val Asn Gly Glu Lys Gly
            180                 185                 190
Val Val Leu Arg Pro Asp Gln Met Lys Trp Thr Ala Pro Leu Lys Pro
        195             200                 205
Phe Ser His Pro Val Asp Ala Val Ile Tyr Glu Thr His Leu Arg Asp
    210             215                 220
Phe Ser Ile His Glu Asn Ser Gly Met Ile Asn Lys Gly Lys Tyr Leu
225             230             235                 240
Ala Leu Thr Glu Thr Asp Thr Gln Thr Ala Asn Gly Ser Ser Ser Gly
            245                 250                 255
Leu Ala Tyr Val Lys Glu Leu Gly Val Thr His Val Glu Leu Leu Pro
            260             265                 270
Val Asn Asp Phe Ala Gly Val Asp Glu Glu Lys Pro Leu Asp Ala Tyr
        275             280                 285
Asn Trp Gly Tyr Asn Pro Leu His Phe Phe Ala Pro Glu Gly Ser Tyr
    290             295                 300
Ala Ser Asn Pro His Asp Pro Gln Thr Arg Lys Thr Glu Leu Lys Gln
305             310                 315                 320
Met Ile Asn Thr Leu His Gln His Gly Leu Arg Val Ile Leu Asp Val
            325                 330                 335
Val Phe Asn His Val Tyr Lys Arg Glu Asn Ser Pro Phe Glu Lys Thr
            340                 345                 350
Val Pro Gly Tyr Phe Phe Arg His Asp Glu Cys Gly Met Pro Ser Asn
        355                 360                 365
Gly Thr Gly Val Gly Asn Asp Ile Ala Ser Glu Arg Arg Met Ala Arg
    370                 375                 380
Lys Phe Ile Ala Asp Cys Val Val Tyr Trp Leu Glu Glu Tyr Asn Val
385                 390                 395                 400
Asp Gly Phe Arg Phe Asp Leu Leu Gly Ile Leu Asp Ile Asp Thr Val
            405                 410                 415
Leu Tyr Met Lys Glu Lys Ala Thr Lys Ala Lys Pro Gly Ile Leu Leu
            420                 425                 430
Phe Gly Glu Gly Trp Asp Leu Ala Thr Pro Leu Pro His Glu Gln Lys
        435                 440                 445
Ala Ala Leu Ala Asn Ala Pro Arg Met Pro Gly Ile Gly Phe Phe Asn
    450                 455                 460
Asp Met Phe Arg Asp Ala Val Lys Gly Asn Thr Phe His Leu Lys Ala
465                 470                 475                 480
Thr Gly Phe Ala Leu Gly Asn Gly Glu Ser Ala Gln Ala Val Met His
            485                 490                 495
Gly Ile Ala Gly Ser Ser Gly Trp Lys Ala Leu Ala Pro Ile Val Pro
            500             505                 510
Glu Pro Ser Gln Ser Ile Asn Tyr Val Glu Ser His Asp Asn His Thr
        515             520                 525
Phe Trp Asp Lys Met Ser Phe Ala Leu Pro Gln Glu Asn Asp Ser Arg
    530             535                 540
Lys Arg Ser Arg Gln Arg Leu Ala Val Ala Ile Ile Leu Leu Ala Gln
545                 550                 555                 560
Gly Val Pro Phe Ile His Ser Gly Gln Glu Phe Phe Arg Thr Lys Gln
```

Gly Val Glu Asn Ser Tyr Gln Ser Ser Asp Ser Ile Asn Gln Leu Asp
            580   585   590
Trp Asp Arg Arg Glu Thr Phe Lys Glu Asp Val His Tyr Ile Arg Arg
        595   600   605
Leu Ile Ser Leu Arg Lys Ala His Pro Ala Phe Arg Leu Arg Ser Ala
        610   615   620
Ala Asp Ile Gln Arg His Leu Glu Cys Leu Thr Leu Lys Glu His Leu
625   630   635   640
Ile Ala Tyr Arg Leu Tyr Asp Leu Asp Glu Val Asp Glu Trp Lys Asp
                645   650   655
Ile Ile Val Ile His His Ala Ser Pro Asp Ser Val Glu Trp Arg Leu
                660   665   670
Pro Asn Asp Ile Pro Tyr Arg Leu Leu Cys Asp Pro Ser Gly Phe Gln
            675   680   685
Glu Asp Pro Thr Glu Ile Lys Lys Thr Val Ala Val Asn Gly Ile Gly
        690   695   700
Thr Val Ile Leu Tyr Leu Ala Ser Asp Leu Lys Ser Phe Ala
705   710   715

        <210> 4
        <211> 1091
        <212> PRT
        <213> K. pneumonia

        <400> 4
Met Leu Arg Tyr Thr Arg Asn Ala Leu Val Leu Gly Ser Leu Val Leu
1   5   10   15
Leu Ser Gly Cys Asp Asn Gly Ser Ser Ser Ser Ser Ser Gly Asn
            20   25   30
Pro Asp Thr Pro Asp Asn Gln Asp Val Val Val Arg Leu Pro Asp Val
        35   40   45
Ala Val Pro Gly Glu Ala Val Thr Ala Val Glu Asn Gln Ala Val Ile
        50   55   60
His Leu Val Asp Ile Ala Gly Ile Thr Ser Ser Ser Ala Ala Asp Tyr
65   70   75   80
Ser Ser Lys Asn Leu Tyr Leu Trp Asn Asn Glu Thr Cys Asp Ala Leu
                85   90   95
Ser Ala Pro Val Ala Asp Trp Asn Asp Val Ser Thr Thr Pro Ser Gly
            100   105   110
Ser Asp Lys Tyr Gly Pro Tyr Trp Val Ile Pro Leu Asn Lys Glu Ser
            115   120   125
Gly Cys Ile Asn Val Ile Val Arg Asp Gly Thr Asp Lys Leu Ile Asp
            130   135   140
Ser Asp Leu Arg Val Ala Phe Gly Asp Phe Thr Asp Arg Thr Val Ser
145   150   155   160
Val Ile Ala Gly Asn Ser Ala Val Tyr Asp Ser Arg Ala Asp Ala Phe
                165   170   175
Arg Ala Ala Phe Gly Val Ala Leu Ala Glu Ala His Trp Val Asp Lys
            180   185   190
Asn Thr Leu Leu Trp Pro Gly Gly Gln Asp Lys Pro Ile Val Arg Leu
            195   200   205
Tyr Tyr Ser His Ser Ser Lys Val Ala Ala Asp Gly Glu Gly Lys Phe
        210   215   220
Thr Asp Arg Tyr Leu Lys Leu Thr Pro Thr Thr Val Ser Gln Gln Val
225   230   235   240
Ser Met Arg Phe Pro His Leu Ser Ser Tyr Ala Ala Phe Lys Leu Pro

6

```
                  245                    250                    255
Asp Asn Ala Asn Val Asp Glu Leu Leu Gln Gly Glu Thr Val Ala Ile
              260                    265                    270
Ala Ala Ala Glu Asp Gly Ile Leu Ile Ser Ala Thr Gln Val Gln Thr
              275                    280                    285
Ala Gly Val Leu Asp Asp Ala Tyr Ala Glu Ala Ala Glu Ala Leu Ser
290                    295                    300
Tyr Gly Ala Gln Leu Ala Asp Gly Gly Val Thr Phe Arg Val Trp Ala
305                    310                    315                    320
Pro Thr Ala Gln Gln Val Asp Val Val Val Tyr Ser Ala Asp Lys Lys
              325                    330                    335
Val Ile Gly Ser His Pro Met Thr Arg Asp Ser Ala Ser Gly Ala Trp
              340                    345                    350
Ser Trp Gln Gly Gly Ser Asp Leu Lys Gly Ala Phe Tyr Arg Tyr Ala
              355                    360                    365
Met Thr Val Tyr His Pro Gln Ser Arg Lys Val Glu Gln Tyr Glu Val
              370                    375                    380
Thr Asp Pro Tyr Ala His Ser Leu Ser Thr Asn Ser Glu Tyr Ser Gln
385                    390                    395                    400
Val Val Asp Leu Asn Asp Ser Ala Leu Lys Pro Asp Gly Trp Asp Asn
              405                    410                    415
Leu Thr Met Pro His Ala Gln Lys Thr Lys Ala Asp Leu Ala Lys Met
              420                    425                    430
Thr Ile His Glu Ser His Ile Arg Asp Leu Ser Ala Trp Asp Gln Thr
              435                    440                    445
Val Pro Ala Glu Leu Arg Gly Lys Tyr Leu Ala Leu Thr Ala Gly Asp
              450                    455                    460
Ser Asn Met Val Gln His Leu Lys Thr Leu Ser Ala Ser Gly Val Thr
465                    470                    475                    480
His Val Glu Leu Leu Pro Val Phe Asp Leu Ala Thr Val Asn Glu Phe
              485                    490                    495
Ser Asp Lys Val Ala Asp Ile Gln Gln Pro Phe Ser Arg Leu Cys Glu
              500                    505                    510
Val Asn Ser Ala Val Lys Ser Ser Glu Phe Ala Gly Tyr Cys Asp Ser
              515                    520                    525
Gly Ser Thr Val Glu Glu Val Leu Asn Gln Leu Lys Gln Ser Asp Ser
              530                    535                    540
Gln Asp Asn Pro Gln Val Gln Ala Leu Asn Thr Leu Val Ala Gln Thr
545                    550                    555                    560
Asp Ser Tyr Asn Trp Gly Tyr Asp Pro Phe His Tyr Thr Val Pro Glu
              565                    570                    575
Gly Ser Tyr Ala Thr Asp Pro Glu Gly Thr Thr Arg Ile Lys Glu Phe
              580                    585                    590
Arg Thr Met Ile Gln Ala Ile Lys Gln Asp Leu Gly Met Asn Val Ile
              595                    600                    605
Met Asp Val Val Tyr Asn His Thr Asn Ala Ala Gly Pro Thr Asp Arg
              610                    615                    620
Thr Ser Val Leu Asp Lys Ile Val Pro Trp Tyr Tyr Gln Arg Leu Asn
625                    630                    635                    640
Glu Thr Thr Gly Ser Val Glu Ser Ala Thr Cys Cys Ser Asp Ser Ala
              645                    650                    655
Pro Glu His Arg Met Phe Ala Lys Leu Ile Ala Asp Ser Leu Ala Val
              660                    665                    670
Trp Thr Thr Asp Tyr Lys Ile Asp Gly Phe Arg Phe Asp Leu Met Gly
              675                    680                    685
Tyr His Pro Lys Ala Gln Ile Leu Ser Ala Trp Glu Arg Ile Lys Ala
              690                    695                    700
```

7

```
Leu Asn Pro Asp Ile Tyr Phe Phe Gly Glu Gly.Trp Asp Ser Asn Gln
705             710             715                 720
Ser Asp Arg Phe Glu Ile Ala Ser Gln Ile Asn Leu Lys Gly Thr Gly
            725             730             735
Ile Gly Thr Phe Ser Asp Arg Leu Arg Asp Ser Val Arg Gly Gly Gly
            740             745             750
Pro Phe Asp Ser Gly Asp Ala Leu Arg Gln Asn Gln Gly Ile Gly Ser
        755             760             765
Gly Ala Gly Val Leu Pro Asn Glu Leu Ala Ser Leu Ser Asp Asp Gln
    770             775             780
Val Arg His Leu Ala Asp Leu Thr Arg Leu Gly Met Ala Gly Asn Leu
785             790             795                 800
Ala Asp Phe Val Met Ile Asp Lys Asp Gly Ala Ala Lys Lys Gly Ser
            805             810             815
Glu Ile Asp Tyr Asn Gly Ala Pro Gly Gly Tyr Ala Ala Asp Pro Thr
        820             825             830
Glu Val Val Asn Tyr Val Ser Lys His Asp Asn Gln Thr Leu Trp Asp
    835             840             845
Met Ile Ser Tyr Lys Ala Ser Gln Glu Ala Asp Leu Ala Thr Arg Val
    850             855             860
Arg Met Gln Ala Val Ser Leu Ala Thr Val Met Leu Gly Gln Gly Ile
865             870             875                 880
Ala Phe Asp Gln Gln Gly Ser Glu Leu Leu Arg Ser Lys Ser Phe Thr
            885             890             895
Arg Asp Ser Tyr Asp Ser Gly Asp Trp Phe Asn Arg Val Asp Tyr Ser
            900             905             910
Leu Gln Asp Asn Asn Tyr Asn Val Gly Met Pro Arg Ile Ser Asp Asp
        915             920             925
Gly Ser Asn Tyr Glu Val Ile Thr Arg Val Lys Glu Met Val Ala Thr
    930             935             940
Pro Gly Glu Ala Glu Leu Lys Gln Met Thr Ala Phe Tyr Gln Glu Leu
945             950             955                 960
Thr Glu Leu Arg Lys Ser Ser Pro Leu Phe Thr Leu Gly Asp Gly Ser
            965             970             975
Ala Val Met Lys Arg Val Asp Phe Arg Asn Thr Gly Ser Asp Gln Gln
            980             985             990
Ala Gly Leu Leu Val Met Thr Val Asp Asp Gly Met Lys Ala Gly Ala
        995             1000            1005
Ser Leu Asp Ser Arg Leu Asp Gly Leu Val Val Ala Ile Asn Ala Ala
    1010            1015            1020
Pro Glu Ser Arg Thr Leu Asn Glu Phe Ala Gly Glu Thr Leu Gln Leu
1025            1030            1035            104
Ser Ala Ile Gln Gln Thr Ala Gly Glu Asn Ser Leu Ala Asn Gly Val
            1045            1050            1055
Gln Ile Ala Ala Asp Gly Thr Val Thr Leu Pro Ala Trp Ser Val Ala
        1060            1065            1070
Val Leu Glu Leu Pro Gln Gly Glu Ala Gln Gly Ala Gly Leu Pro Val
        1075            1080            1085
Ser Ser Lys
    1090


    <210> 5
    <211> 6
    <212> PRT
    <213> Artificial Sequence

    <220>
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8

```
<223> Unknown

<400> 5
Asp Val Val Ile Asn His
1               5


<210> 6
<211> 9
<212> PRT
<213> Artificial Sequence

<220>
<223> Unknown

<400> 6
Gly Phe Arg Leu Asp Ala Ala Lys His
1               5


<210> 7
<211> 6
<212> PRT
<213> Artificial Sequence

<220>
<223> Unknown

<400> 7
Phe Val Asp Val His Asp
1               5


<210> 8
<211> 5
<212> PRT
<213> Artificial Sequence

<220>
<223> Unknown

<400> 8
Tyr Asn Trp Gly Tyr
1               5


<210> 9
<211> 4
<212> PRT
<213> Artificial Sequence

<220>
<223> Unknown

<400> 9
Val Trp Ala Pro
1
```